

Remarks:

The above amendments and these remarks are responsive to the Office action dated October 5, 2005.

Prior to entry of this Amendment, claims 1-49 remained pending in the application. Pursuant to an earlier restriction requirement, claim 44 was withdrawn from further consideration in the present application. By this amendment, claim 44 is cancelled without prejudice. No new claims are added. Claims 1-43 and 45-49 thus remain pending upon entry of this Amendment.

In the Office action, the Examiner indicates that claims 4, 19, 29, 38, 39 and 48 would be allowable if rewritten in independent form. However, claims 1-2, 7-12, 16, 17, 22-27 and 32-37 stand rejected under 35 USC §102(b) as being unpatentable over Cillessen et al (US 5,744,864); claims 3, 5, 6, 18, 20, 21, 28, 30 and 31 stand rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. in view of Minami et al. (Japanese Journal of Applied Physics, Vol. 23, pp. L 1693-1696 (1994)); claims 40-43, 45 and 46 stand rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. in view of Ando et al. (US 6,184,946); and claims 47 and 49 stand rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. in view of Ando et al. and further in view of Minami et al. Applicants respectfully traverse the rejections for the reasons indicated below.

In view of the amendments above, and the remarks below, applicants respectfully request reconsideration of the application under 37 C.F.R. § 1.111 and allowance of the pending claims.

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Rejections under 35 USC § 112

First considering formal matters, applicants note that claims 14 and 15 have been rejected under 35 USC §112. In particular, the Examiner asserts that there is insufficient antecedent basis for "the dielectric material" in lines 1 of claims 14 and 15. By this amendment, applicants have amended claim 14 to depend from claim 13, thus providing antecedent basis for "the dielectric material in claims 14 and 15 (claim 15 depends from claim 14). The rejection of claims 14 and 15 under 35 USC §112 thus is overcome. Inasmuch as no further rejections of claims 14 and 15 are given, applicants understand that such claims are allowable over the record art.

Rejections under 35 USC § 102(b)

Claims 1-2, 7-12, 16, 17, 22-27 and 32-37 stand rejected under 35 USC § 102(b) as being unpatentable over Cillessen et al (US 5,744,864). Applicants respectfully disagree, and assert that the Examiner has failed to establish a *prima facie* case of anticipation of the claims.

Cillessen et al. relates to a transparent semiconductor device having a transparent switching element. More particularly, Cillessen et al. discloses a device having a channel region formed of a covalent oxide of a non-transition metal provided with dopant atoms. Cillessen et al. further specifies that the oxide is degenerately doped with a concentration of dopant atoms of between 0.001% and 0.3% in order to achieve sufficiently high conductivity for the device's intended use. Cillessen et al. does not specify a channel comprised of a compound containing zinc, tin and oxygen. In fact, Cillessen et al. expressly teaches away from such a channel by requiring doped metal oxides.

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Claim 1 recites, in part, a semiconductor device including "a channel... comprised of a ternary compound containing zinc, tin, and oxygen...." Claim 16 recites, in part, a three-port semiconductor device including "a means for providing a channel... formed at least in part from a ternary compound containing zinc, tin, and oxygen." Claim 25 recites, in part a thin film transistor including "a channel layer formed from a zinc-tin oxide material...." Claims 2 and 7-12 depend from claim 1, claims 17 and 22-24 depend from claim 16, and claims 26, 27 and 32-37 depend from claim 25.

As noted above, Cillessen et al. specifies only that the channel be formed of "covalent oxides of a non-transition metal provided with dopant atoms." Cillessen et al. does not even mention a ternary compound containing zinc, tin and oxygen, as recited in each of claims 1, 16 and 25. Claims 1, 16 and 25 thus cannot be anticipated by Cillessen et al., and the rejection of these claims under 35 USC § 102(b) must be withdrawn. Furthermore, since claims 2 and 7-12 depend from claim 1, claims 17 and 22-24 depend from claim 16, and claims 26, 27 and 32-37 depend from claim 25, applicants assert that these claims cannot be anticipated by Cillessen et al. for at least the same reasons as claims 1, 16 and 25.

In discussing the channel region, Cillessen et al. discloses eight binary oxides (Ga_2O_3 , Bi_2O_3 , SnO_2 , ZnO , Sb_2O_3 , PbO , GeO_2 , and In_2O_3) and three ternary oxides (GaInO_3 , ZnGa_2O_3 and CdGa_2O_4). Zinc-tin oxide is noticeably absent from this list. Although Cillessen et al. does indicate that mixtures of these oxides or compounds formed from these oxides may be used, such indication is insufficient to anticipate the recited zinc-tin oxide carrier, and would not even be sufficient disclosure for one of ordinary skill to immediately envisage a ternary zinc-tin oxide.

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There are at least 45 possible combinations of the binary oxides disclosed by Cillessen et al., and more accurately, 78 or more ternary oxides of all non-transition metals. This large number of unspecified ternary oxides makes clear that one of ordinary skill would not immediately envisage the ternary zinc-tin oxide recited in the claims of the present application from the general statement of Cillessen et al. Accordingly, the broad characterization of possible combinations of binary oxides in Cillessen et al. does not render the claimed compound obvious.

Furthermore, Cillessen et al. actually teaches contrary to the recited channel comprised of a zinc-tin compound containing zinc, tin and oxygen. The thrust of the Cillessen et al. disclosure is to dope the channel region of a semiconductor device with a sufficient concentration of doing atoms (between 0.001% and 0.3%) to achieve a sufficiently high conductivity of the channel. In contrast, as noted by applicants on page 3, lines 28-31 of the original specification, a zinc-tin oxide channel reveals a high degree of charge mobility. Accordingly, there is no need to dope the channel region of a zinc-tin oxide channel, as is proposed by Cillessen et al. The central purpose of Cillessen et al. thus would be obliterated if a zinc-tin oxide channel were employed.

Cillessen et al. also fails to anticipate every element of claims 8, 9, 33 and 34 for the following reasons. Claims 8 and 33 recite that the channel further includes "phase segregated ZnO." Claims 9 and 34 recite that the channel further includes "phase segregated SnO₂." The Examiner asserts that "the channel further includes, based on the presence of the claimed ZnSnO₃ compound, phase segregated ZnO and SnO₂ by virtue of the finite dissociation constant of ZnSnO₃." Applicants submit that although the ZnSnO₃ compound is specifically recited in claim 3 and claim 28,

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claims 8 and 9 and claims 33 and 34 depend from claim 2 and claim 27, respectively, and these claims recite "a zinc-tin oxide compound having the following stoichiometry: $Zn_xSn_yO_z$, where x, y and z have positive non-zero values." The Examiner's assertion is therefore in error.

Moreover, as noted above, Cillessen et al. fails to specifically disclose, teach, or suggest a zinc-tin oxide of any stoichiometry, and fails to disclose the phase segregation of any ternary oxide formed from any combination of non-transition metal oxides. Since Cillessen et al. fails to disclose every element of these claims, applicants submit that claims 8, 9, 33, and 34 are allowable for at least these additional reasons, and request the withdrawal of the rejection of these claims under 35 USC §102(b) over Cillessen et al.

Claims 12, 23 and 37 recite source and drain electrodes, or first and second electrodes, that include an indium-tin oxide material. The Examiner asserts that Cillessen et al. teaches the further limitations of these claims. Applicants, however, submit that Cillessen et al. fails to teach, disclose, or suggest the specific combination of elements recited by these claims as amended above. Specifically, Cillessen teaches, "In a preferred embodiment, the connection electrodes, the gate electrodes, and the channel region comprise the same basic material provided with dopant atoms of the same type..." (Cillessen et al. col. 2, lines 31-33).

Based on the Examiner's characterization, the connection electrodes of Cillessen et al. correspond to the source and drain electrodes of claims 12 and 23, and to the first and second electrodes of claim 37. The devices of these claims employ a first material (zinc-tin oxide) for the channel region and a different second material (indium-tin oxide) for the electrodes. Consequently, the device taught by

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Cillessen et al. is distinctly different from the device of these claims. Since Cillessen et al. fails to disclose every element of claims 12, 23, and 37, applicants submit that these claims are allowable for at least these reasons, and request the withdrawal of the rejection of these claims under 35 USC §102(b) over Cillessen et al.

Rejections under 35 USC §103(a)

Claims 3, 5, 6, 18, 20, 21, 28, 30 and 31 stand rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. in view of Minami et al. (Japanese Journal of Applied Physics, Vol. 23, pp. L 1693-1696 (1994)). Claims 40-43, 45, and 46 are rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. In view of Ando et al. (US 6,184,946). Claims 47 and 49 are rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. in view of Ando et al. and further in view of Minami et al.

In particular, with respect to claims 3, 5, 6, 18, 20, 21, 28, 30, and 31, the Examiner has acknowledged that Cillessen et al. fails to anticipate the further features set forth in these claims, and thus turns to Minami et al. Minami et al. relates to highly transparent and conductive zinc-stannate thin films prepared by RF Magnetron sputtering. Minami et al. teaches that "the zinc-stannate thin films may be useful for window coatings and as weather-proof transparent electrodes for thin film solar cells and other practical devices" (Minami et al., page L 1695, second column, final paragraph).

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Applicants submit that the application for the zinc-tin oxide of the present application is different from the application for the zinc-stannate films of Minami et al., rendering the combination of Cillessen et al. and Minami et al. inappropriate. Moreover, since claims 3, 5, and 6, depend from claim 2, since claims 18, 20, and 21 depend from claim 17, and since claims 28, 30, and 31 depend from claim 27, applicants submit that these claims are allowable for at least the same reasons as the respective base claims, which have been noted above. Claims 3, 5, 6, 18, 20, 21, 28, 30, and 31 are therefore allowable, and applicants request the withdrawal of the rejection under 35 USC §103(a) over Cillessen et al. in view of Minami et al.

Turning now to claims 40-43, 45, and 46 which stand rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. in view of Ando et al. Claim 40 recites, in part, a method of controlling an active matrix display including, "providing a three-port semiconductor device, where the semiconductor device includes a zinc-tin oxide channel layer...." Claim 45 recites, in part, a plurality of display elements configured to operate collectively to display images, including "a channel ... comprised of a ternary compound containing zinc, tin, and oxygen...." Claims 41-43 depend from claim 40. Claim 46 depends from claim 45.

The Examiner has asserted that Cillessen et al. discloses the channel of claims 40 and 45. Applicants respectfully disagree. As noted above in reference to claims 1, 16, and 25, Cillessen fails to teach, disclose, or suggest the specific combination of zinc, tin, and oxygen from among more than 36 possible ternary oxides of non-transition metals.

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The Examiner has also asserted that Cillessen et al. fails to teach the active matrix display recited by claims 40, nor the plurality of display elements recited by claim 45, and thus turns to Ando et al. Ando et al. relates to an active matrix liquid crystal display. The device disclosed by Ando includes a plurality of thin film transistors that include a channel layer that is formed from an amorphous silicon material, or, alternatively, "poly-silicon or fine-crystal silicon" (Ando et al., col. 5, line 47). Ando et al. does not disclose fabricating a channel from any other material other than these various forms of silicon.

Silicon has a bandgap energy of 1.1 electron volts. (eV) Cillessen et al. a device that includes a channel material having a bandgap energy of greater than 2.5 eV. Silicon, therefore, is unsuitable for the device taught by Cillessen et al., and applicants submit that the combination of the Cillessen et al. reference and the Ando et al. reference is therefore inappropriate. Applicants submit that neither Cillessen et al. nor Ando et al., taken either alone or in combination, teach every element of claims 40 and 45. Accordingly, these claims are allowable for at least these reasons, and applicants request the withdrawal of the rejections of claims 40 and 45 under 35 USC §103(a). Moreover, since claims 41-43 depend from claim 40, and claim 46 depends from claim 45, these claims are allowable for at least the same reasons as claims 40 and 45, and applicants request the withdrawal of the rejections of these claims under 35 USC §103(a).

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Turning now to claims 47 and 49, which stand rejected under 35 USC §103(a) as being unpatentable over Cillessen et al. in view of Ando et al., further in view of Minami et al. These claims depend from claim 46. The Examiner asserts that neither Cillessen et al. nor Ando et al. discloses the further limitations of claims 47 and 49, and thus turns to Minami et al.

As noted above, applicants submit that neither Cillessen et al., nor Ando et al., nor Minami et al. teaches a channel formed from the specific ternary zinc-tin oxide compound recited in claim 46. Therefore, neither Cillessen et al., nor Ando et al., nor Minami et al. (taken either alone or in combination) teach every element of claims 47 and 49. Additionally, applicants submit, as noted above, that the individual combinations of these references are inappropriate. Accordingly, these claims are allowable for at least these reasons, and applicants request the withdrawal of the rejections of claims 47 and 49 under 35 USC §103(a). Moreover, since claims 47 and 49 depend from claim 46, these claims are allowable for at least the same reasons as claim 46.

Allowable Subject Matter

The Examiner has also indicated that claims 4, 19, 29, 38, 39, and 48 would be allowable if rewritten in independent form. The Examiner further provides a statement of reasons for the indication of allowable subject matter. Applicants respectfully agree with the Examiner's conclusions regarding the patentability of these claims, without necessarily agreeing with or acquiescing in the Examiner's reasoning. In particular, applicants believe that the claims are allowable because the prior art fails to teach or suggest the invention as claimed.

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Conclusion

Applicants believe that this application is now in condition for allowance, in view of the above amendments and remarks. Accordingly, applicants respectfully request that the Examiner issue a Notice of Allowability covering the pending claims. If the Examiner has any questions, or if a telephone interview would in any way advance prosecution of the application, please contact the undersigned attorney of record.

Respectfully submitted,

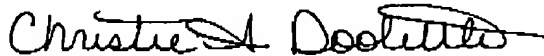
KOLISCH HARTWELL, P.C.



Walter W. Kamstein
Registration No. 35,565
520 S.W. Yamhill Street, Suite 200
Portland, Oregon 97204
Telephone: (503) 224-6655
Facsimile: (503) 295-6679
Attorney for Applicants

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I hereby certify that this correspondence is being facsimile transmitted to Examiner J. Mondt, Group Art Unit 3663, Assistant Commissioner for Patents, at facsimile number (571) 273-8300 on January 5, 2006.



Christie A. Doolittle

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